duplex containing mismatched bases. Thus, the higher the stringency, the greater the probability that two single-stranded polynucleotides, capable of forming a mismatched duplex, will remain single-stranded. Conversely, at lower stringency, the probability of formation of a mismatched duplex is increased.

[0101] The appropriate stringency that will allow selection of a perfectly-matched duplex, compared to a duplex containing one or more mismatches (or that will allow selection of a particular mismatched duplex compared to a duplex with a higher degree of mismatch) is generally determined empirically. Means for adjusting the stringency of a hybridization reaction are well-known to those of skill in the art.

[0102] The term "chip" or "microchip" refers to a small device or substrate that comprises components for performing certain functions. A chip includes substrates made from silicon, glass, metal, polymer, or combinations and capable of functioning as a microarray, a macroarray, a fluidic device, and/or an integrated circuitry component. A chip may be a microelectronic device made of semiconductor material and having one or more integrated circuits or one or more devices. A "chip" or "microchip" is typically a section of a wafer and made by slicing the wafer. A "chip" or "microchip" may comprise many miniature transistors and other electronic components on a single thin rectangle of silicon, sapphire, germanium, silicon nitride, silicon germanium, or of any other semiconductor material. A microchip can contain dozens, hundreds, or millions of electronic components. In the embodiments of the invention, as discussed herein, fluidic zones, magnetic microcoil arrays, detection elements, and vibration elements can also be integrated into a microchip.

[0103] "Micro-Electro-Mechanical Systems (MEMS)" is the integration of mechanical elements, sensors, actuators, and electronics on a common silicon substrate through microfabrication technology. While the electronics are fabricated using integrated circuit (IC) process sequences (e.g., CMOS, Bipolar, or BICMOS processes), the micromechanical components could be fabricated using compatible "micromachining" processes that selectively etch away parts of the silicon wafer or add new structural layers to form the mechanical and electromechanical devices. Microelectronic integrated circuits can be thought of as the "brains" of a system and MEMS augments this decision-making capability with "eyes" and "arms", to allow microsystems to sense and control the environment. Sensors gather information from the environment through measuring mechanical, thermal, biological, chemical, optical, and magnetic phenomena. The electronics then process the information derived from the sensors and through some decision making capability direct the actuators to respond by moving, positioning, regulating, pumping, and filtering, thereby controlling the environment for some desired outcome or purpose. Because MEMS devices are manufactured using batch fabrication techniques similar to those used for integrated circuits, unprecedented levels of functionality, reliability, and sophistication can be placed on a small silicon chip at a relatively low cost. In the embodiments of the invention, as discussed herein, MEMS devices can be further integrated with fluidic zones, diffusion barriers, magnetic microcoil arrays, detection elements, and/or vibration elements, such that, together, they perform separation and detection function for biomolecules.

[0104] An "integrated circuitry component" is a processor on an integrated circuit (IC) chip. The processor may be one or more processor on one or more IC chip. The chip is typically a silicon chip with thousands of electronic components that serves as a central processing unit (CPU) of a computer or a computing device. It is typically a readable and writable memory chip, with or without contact. In certain embodiments, it can store reagent information, operation instructions and programs, and test results and data.

[0105] A "nanomaterial" as used herein refers to a structure, a device or a system having a dimension at the atomic, molecular or macromolecular levels, in the length scale of approximately 1-1000 nanometer (nm) range. Preferably, a nanomaterial has properties and functions because of the size and can be manipulated and controlled on the atomic level.

[0106] The term "complementary" refers to the topological compatibility or matching together of interacting surfaces of an analyte and its corresponding affinity agent. Thus, the affinity agent and its analyte can be described as complementary, and furthermore, the contact surface characteristics are complementary to each other. With respect to polynucleotides, sequences are complementary when they are able to hybridize to each other to form a stabilized duplex.

[0107] One embodiment of the invention relates to a device for detecting the presence or amount of an analyte in a sample. The device comprises a fluidic network and an integrated circuitry component which is functionally coupled to a magnetic microcoil array, a detection element, a circuit board, and optionally, a vibration element. In the embodiment, the fluidic network comprises a plurality of fluidic zones, where each zone is connected to the adjacent zone by a diffusion barrier. One or more of the fluidic zones contains a magnetic particle and a signal particle. A sample suspected of containing an analyte is introduced into a fluidic zone. The analyte interacts with a magnetic particle and the signal particle to form a binding complex. The magnetic microcoil array is to generate a magnetic field across at least a portion of a fluidic zone to move the binding complex to a fluidic zone where it can be detected by the detection element.

[0108] In one embodiment, the fluidic device integrates fluidic zones and a microcoil for generating a magnetic field within a portion of a fluidic zone. The fluidic zones and the microcoil may be supported by or integrated into a substrate. In another embodiment, the microcoil is placed near the substrate. When activated, the microcoil generates a magnetic field within a portion of a fluidic zone.

[0109] In a specific embodiment of the invention, the detection element of the substrate comprises silicon, glass, a polymeric material, metal, or a combination thereof. More specifically, the detection element may either comprise or be connected to an integrated circuit, a MEMS device, a microarray, a macroarray, a fluidic device, or a combination thereof. In other words, the embodiment can be integrated into or connected to a wide range of materials used in a variety of existing devices.

[0110] Silicon is a suitable material for forming microchannels coupled with microelectronics or other microelectromechanical systems (MEMS). It also has good stiffness, allowing the formation of fairly rigid microstructures, which can be useful for dimensional stability. In a specific embodiment of the invention, the fluidic device or substrate comprises an integrated circuitry element (IC), a packaged integrated circuit, and/or an integrated circuit die. For example, the substrate may be a packaged integrated circuit that comprises a microprocessor, a network processor, or other processing device. The substrate may be constructed using, for example, a Controlled Collapse Chip Connection (or "C4")